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DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. § 371**

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INTERNATIONAL APPLICATION NO.

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INTERNATIONAL FILING DATE

06 March 2000

PRIORITY DATE CLAIMED

05 March 1999

TITLE OF INVENTION

METHOD FOR ALLOCATING RESOURCES IN A RADIO COMMUNICATIONS SYSTEM

APPLICANT(S) FOR DO/EO/US

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Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

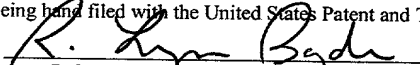
1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☒ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application under PCT Article 19 (35 U.S.C. 371(c)(2)).
 - a. ☒ is attached hereto.
 - b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3)).
 - a. ☒ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
8. ☒ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information: 1) IPER; 2) Int'l Search Report; 3) Application Data Sheet; 4) Return receipt postcard.

CERTIFICATE OF HAND DELIVERY

I hereby certify that this correspondence is being hand filed with the United States Patent and Trademark Office in Washington, D.C. on September 5, 2001.


R. Lynn Boyden

U.S. APPLICATION NO. (if known, see 37 CFR 1.5) Not yet assigned 09/914799		INTERNATIONAL APPLICATION NO. PCT/DE00/00694		ATTORNEY'S DOCKET NUMBER: 449122010100	
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21. <input checked="" type="checkbox"/> The following fees are submitted: BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....\$1,000.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.....\$860.00 International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....\$710.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provision of PCT Article 33(1)-(4)\$690.00 International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)\$100.00				CALCULATIONS PTO USE ONLY	
ENTER APPROPRIATE BASIC FEE AMOUNT =				\$860.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$0	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	17 - 20 =	0	x \$18.00	\$0	
Independent claims	1 - 3 =	0	x \$80.00	\$0	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$270.00	\$270.00	
TOTAL OF ABOVE CALCULATIONS =				\$1,130.00	
<input type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				\$0	
SUBTOTAL =				\$1,130.00	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				+	\$0
TOTAL NATIONAL FEE =				\$1,130.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				+	\$40.00
TOTAL FEES ENCLOSED =				\$1,170.00	
				Amount to be refunded:	\$
				charged:	\$

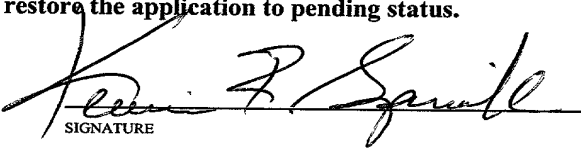
a. ☒ Please charge my **Deposit Account No. 03-1952** in the amount of \$1,170.00 to cover the above fees. A duplicate copy of this sheet is enclosed.

b. ☒ The Commissioner is hereby authorized to charge any additional fees that may be required, or credit any overpayment to **Deposit Account No. 03-1952**.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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Description

Method for resource allocation in a radio communication system

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The invention relates to a method for resource allocation in a radio communications system, and to a radio communications system designed in such a way.

- 10 WO 98/08353 A2 describes a mobile radio system in which a number of base stations, which each form a radio cell, are each allocated to one base station controller. Base stations in the boundary area between the regions of two base station controllers can
15 optionally be controlled by each of these controllers.

Messages (for example voice, video information or other data) are transmitted via a radio interface by means of electromagnetic waves in radio communications systems.

- 20 The radio interface relates to a connection between a base station and subscriber stations, in which case the subscriber stations may be mobile stations or stationary radio stations.

- 25 Radio communications systems are generally of cellular design, in order to allow mobile subscribers to have access to different supply regions, which are referred to as radio cells. Only a limited number of resources are available in radio communications systems since the
30 radio interface in each radio cell has a relatively narrow bandwidth in comparison to a landline network, and these resources may differ, depending on the chosen multiplexing method, in frequency, timing and, in the case of code-division multiplexing, in their signal
35 form, and they each provide a specific transmission rate.

services for the individual subscriber stations. To do this, the available resources and their allocation to specific connections must be managed in each radio cell.

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In addition, interaction between adjacent base stations (NodeB) and base station controllers (RNC) is required in cellular radio communications systems, in order to prevent multiple allocation of resources, and hence unnecessary interference. This results in a considerable amount of signaling complexity in the radio communications system.

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According to the previous UTRAN system architecture (Universal Telecommunications Radio Access Network), in this context see Tdoc SMG2 512/98, ETSI STC SMG2 #28, Dresden, November 16, 1998, the problem is solved or circumvented by the possible dynamic for resource allocation being deliberately restricted. To do this, the base station controller allocates exclusively to each connection as many dedicated channels (DCH) as are required for transmission of the peak value of the data rate for real time services (RT).

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If the allocated RT capacity is not all required at certain periods owing to variable data rates, it is admittedly possible for services which are not real time services (non-real-time or NRT services) to transmit packets in addition. However, it is impossible to transmit data from other subscriber stations. The allocation (scheduling) of the resources for the services to the DCH of a subscriber station is carried out by an entity for resource monitoring, which is referred to as the dedicated Medium Access Control (MAC-d), specifically for each subscriber station. No direct interaction between different MAC-d entities is envisaged.

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Furthermore, it is possible to transmit NRT services in a common channel in the downlink direction (Downlink

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Shared Channel DSCH). These are resources, which are managed by a common entity of the shared MAC (MAC-sh), in each cell, which can be temporarily allocated to different subscriber stations for specific frame periods. The MAC-sh is set up on a cell-specific basis, and no direct interaction between different MAC-sh entities is envisaged.

The logical separation of DCHs and DSCHs leads to the following disadvantages owing to the involvement of a number of MAC entities, which are in general physically separated from one another in different base station controllers and can therefore communicate with one another only with considerable signaling complexity:

While, in the case of exclusive transmission by DCH, all the codes for CDMA radio transmission (CDMA code division multiple access) can be used optimally by adaptive data compression, this advantage is partially lost when DSCH is used, since individual services cannot be shared between DCH and DSCH with an acceptable level of complexity, and a rate matching process is carried out separately for DCH and DSCH. Thus, in general, more transmission capacity (that is to say more resources) is required overall for one subscriber station than would be possible if all the services were multiplexed into one data stream.

Since the DSCH must have a high transmission capacity for effective use, and a large amount of resources are therefore reserved exclusively for it, this is, however, suitable only for transmitting NRT services, this can prevent approval for new connections for RT services (hard blocking).

Owing to the necessary DCH allocation corresponding to the maximum data rate for all the RT services for a subscriber station, hard blocking can occur even though a large number of allocated resources are not required

hard blocking can occur even though a large number of allocated resources are not required for transmission all the time when variable data rates are used.

- 5 The signaling of a data transmission in the DSCH for a specific subscriber station by means of the TFCI parameter (TFCI Transport Format Combination Indicator) in the associated DCH is cumbersome and, furthermore, reduces the maximum number of transport format combinations (TFC Transport Format Combination) which
10 can be transmitted in the TFCI, since TFCI bits must be reserved exclusively for the DSCH.

- The soft handover service feature, which considerably
15 increases the transmission reliability and can result in a reduction in the overall interference in WCDMA systems (wideband CDMA), is not available with the current DSCH concept. For a soft handover, one subscriber station is temporarily supplied from at
20 least two base stations.

- The interaction of said factors when transmitting services with variable data rates allows the possible capacity of the radio interface to be used only to a
25 limited extent.

- The invention is thus based on the object of improving the radio resource management in radio communications systems. This object is achieved by the method having
30 the features of claim 1, and by the radio communications system having the features of claim 14. Advantageous developments are described in the dependent claims.

- 35 In the following text, the resources are referred to as channels, in which case, depending on the chosen multiplexing method, a channel is characterized by a frequency band and/or a timeslot and/or a code and/or other separation options.

A number of base stations in a radio communications system are normally controlled by one base station controller in each case, with regard to resource allocation. However, one base station provides only a limited number of channels, which can be allocated to connections from and to different subscriber stations.

According to the invention, some of the channels which can be provided by the base stations are used for exclusive monitoring of the associated base station controller, with the intention of a second base station controller being able to use them dynamically, without further agreement by the base station controller. The number of channels in this portion can be varied, with the involvement of the second base station controller. The reservation of channels for the second base station controller reduces the signaling complexity. The change to the portion of the channels which are used for exclusive monitoring of the associated base station controller is not carried out on a frame-by-frame basis but as required, that is to say generally at relatively long time intervals.

The previous subscriber-related reservation of resources in adjacent cells by the base station controller is thus replaced by resource reservation which is related to the area (RNS - Radio Network Subsystem) monitored by the respective adjacent base station controllers (RNC). The direct monitoring of a specific proportion of the transmission capacity in its own cells is transmitted to the adjacent RNC. This approach satisfies the precondition to allow the MAC-d entities in each RNC to manage the resources monitored by them dynamically. It is thus not only possible to support the soft combining service feature but also to avoid the interference between cells which belong to different RNC areas during non-orthogonal resource allocation.

The method according to the invention also avoids the need for time-consuming checking with the adjacent RNCs on each occasion before allocation of a resource. This reservation of resources in adjacent cells is not only worthwhile in order to allow a soft handover in the downlink direction for W-CDMA, but also to avoid undesirable interference between the radio cells in TD-CDMA (time division CDMA).

According to one advantageous refinement of the invention, the number of channels which are assigned to the second RNC is matched cyclically to the traffic volume. This is done by signaling between the RNCs. This signaling complexity is considerably less than for continuous subscriber-related resource sharing between the RNS areas. The sharing of capacity is thus optimized, and the risk of hard blocking by signaling and prior reservation between the RNCs involved is kept low.

According to a further refinement of the invention, the RNC carries out subscriber-related allocation of the channels, in which case one channel can also be allocated to a number of subscriber stations. Only one entity may be set up for each subscriber station in the RNC. The logical separation between DCH and DSCH is cancelled in the MAC layer. There is now only one dedicated MAC entity in the RNC for each subscriber station, and this can access all the resources which have been released by the RNC for data transmission by the corresponding subscriber station. In principle, each resource can be allocated to a number of subscriber stations in order to avoid unused resources for services whose data rates are variable.

The allocation of channels is advantageously dynamically adapted from timeslot to timeslot. The method according to the invention thus relates to completely dynamic allocation of resources and does not involve the otherwise high level of signaling

complexity. It must be possible to switch a channel very quickly between different subscriber stations after each transmission frame (approximately every 10 ms for UTRAN) since the data rates generally change dynamically, in order to avoid unused resources and hence to maximize the spectral efficiency.

A further refinement provides for the subscriber-related entities of the individual subscriber stations to interact in the RNC. This optimizes access to the available resources within an RNC. The subscriber-related MAC-d entities to this end communicate via cell-related tables, in which the allocation of the available resources to the subscriber stations located in the radio cell is continuously updated. Multiple allocations are avoided by the communication between the subscriber-related MAC-d entities.

The allocation of priorities for the individual subscriber stations when allocating resources makes it possible to guarantee qualities of service for RT services, while nevertheless optimally using all the resources. When priorities are equal, the use of the channel is governed by dynamic prioritization on the basis of the transmission situation, or the time sequence of a resource request.

Resource tables (Shared Channel Table SCT) are advantageously set up for resource management and indicate, for all channels, which priority is allocated to which subscriber stations for that channel, and which subscriber station is currently using that channel. A table is set up in the RNC for each cell in which subscriber stations are located and which are managed by the RNC. This table in each case controls the resources in a radio cell which are monitored by that RNC. The table ensures that none of these resources is used by a number of MAC-d entities at the same time. The entries in the table are adapted dynamically with regard to allocation. While a

connection is in existence, dynamic resource allocation is carried out in such a manner that each MAC-d entity requests appropriate resources, depending on the amount of data to be transmitted at that time for its subscriber station, with the SCTs on those radio cells which are involved in the connection (only ever one radio cell without a soft handover).

It is thus also possible to allocate resources which are as orthogonal as possible to the various base stations within the supply area of an RNC when using a TDMA-based transmission method (time division multiple access). This minimizes the interference between the radio cells.

The free capacity which can still be used in each resource is determined in each RNC by statistical evaluation of the SCT utilization. This is used to allocate a specific subset of the available resources with appropriate priorities to the new subscriber stations as optimally as possible when setting up new connections and, from this and in combination with the data rates of the services to be transmitted, to determine the required transport format combinations.

If a subscriber station requires a handover to a radio cell whose resources cannot be accessed by the RNC (SRNC) responsible for that subscriber station, since no adequate reservation has been made or can be made, the SRNC functionality is relocated (SRNC relocation).

An exemplary embodiment of the invention will be explained in more detail with reference to the attached drawings, in which:

Figure 1 shows a radio communications system,

Figures 2, 3 show a cellular breakdown of the radio supply region into different RNS areas for W-CDMA and TD-CDMA, respectively,

Figure 4 shows the channel allocation for soft handover with W-CDMA,

5 Figures 5, 6 show a channel allocation for W-CDMA and TD-CDMA, respectively,

Figure 7 shows the use of a table for channel allocation in the RNC, and

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Figures 8, 9 show one form of signaling for an inter-RNC soft handover.

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The mobile radio system illustrated in Figure 1 as an example of a radio communications system comprises a large number of mobile switching centers MSC which are networked to one another and produce access to a landline network PSTN. Furthermore, each of these mobile switching centers MSC is connected to at least one base station controller RNC for controlling the base stations BS and for allocating radio resources. Each of these base station controllers RNC in turn allows a connection to at least one base station BS. However, the base station controllers RNC can also be networked with one another as shown in Figure 8.

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A base station BS can use a radio interface to set up a connection to a subscriber station, for example mobile stations MS or other mobile and stationary terminals. At least one radio cell is formed by each base station BS.

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By way of example, Figure 1 shows connections V1, V2, V3 for transmitting user information ni and signaling information si as point-to-point links between subscriber stations MS and a base station BS.

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An operation and maintenance center OMC provides monitoring and maintenance functions for the mobile radio system, or for parts of it. The functionality of

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this structure can be transferred to other radio communications systems in which the invention can be used, in particular for subscriber access networks with wire-free subscriber access, and for base stations and subscriber stations operating in the unlicensed frequency band.

The invention will be explained in the following text with reference to two different radio interfaces, to be precise for a W-CDMA radio interface using the FDD mode (frequency division duplex) and for a TD-CDMA radio interface using the TDD mode (time division duplex). Further details of radio communications systems with such radio interfaces can be found, for example, in DE 198 35 643 and DE 198 20 736.

Figure 2 shows a cellular radio communications system having a W-CDMA radio interface and comprising a large number of radio cells. One radio cell is in this case supplied from one base station BS, with the radio cells of a number of base stations BS forming an area RNS (radio network subsystem) which is in each case monitored by one base station controller RNC. Six channels are provided, for example, as radio resources for supplying the subscriber stations MS in each of the radio cells. The channels are formed by means of a spread code, see Figure 5, and a frequency band (bandwidth 5 MHz). Some of the channels in each radio cell are intended for allocation by that particular base station controller RNC, while others of the channels are reserved for adjacent areas RNS and can be allocated by the responsible base station controllers RNC there.

In the center of an area, for example RNS1, all the channels can be made available to that area without any reservations being made for adjacent RNSs. The number of reserved channels, that is to say the transmission capacity which has been reserved for management by adjacent base station controllers RNC, can be variable

in the individual radio cells and can be set as required. This is done by means of a signaling interchange between the base station controllers RNC, thus corresponding to the varying amount of traffic.

5 However, the signaling complexity is considerably less than for subscriber-related reservation.

The channels in a radio cell are also subdivided in a radio communications system having a TD-CDMA radio interface as shown in Figure 3. Some of the channels can be allocated by the base station controller RNC of the radio cell without any restriction, while others are subject to allocation restrictions, in order to limit the interference for adjacent cells. The restriction occurs in particular at the edges of an RNS area, since the RNC has no information about the channel allocation in the adjacent RNS.

Further particular channels are allocated to an adjacent RNS. In this case as well, some of the channels are subjected to exclusive monitoring by the base station controller RNC which controls the base station BS for the radio cell. Some of the channels can be allocated only by base station controllers RNCs of adjacent cells or after interference measurements in the channels. The capacity allocation to restricted, unrestricted, or no use (that is to say use by adjacent cells) can be varied depending on the traffic load at the time.

30 The same channels can also be reserved for restrictive use in adjacent RNSs. An interference measurement, which is carried out by the base stations BS or else with the assistance of measurements from subscriber stations MS, is used to determine whether the channel is already being used or is subject to excessive interference. If this is not the case, then the base station controller RNC allocates that channel without referring back to any other RNCs. Channels such as

40 these are preferably used for NRT services, for which

an adequate quality of service can be guaranteed by repeated transmission or by other measures, even when reception is subject to interference at times.

5 Figure 4 shows the use of channels by subscriber stations MS1 to MS4 which are located in the supply area of different base stations BS, with the base stations BS being controlled by different base station controllers RNC. Some of the channels of an RNS which
10 is monitored by an RNC1 to RNC3 are in each case reserved for the adjacent RNC or RNCs. As shown in Figure 4, the channels are subdivided into dedicated and shared channels DPC, SPC. The dedicated channels DPC are each allocated exclusively to one subscriber
15 station MS, while the shared channels SPC can be used alternately by different subscriber stations MS. This means that it is possible to produce a better match to the different character of the services and the variable data rates. A subscriber station MS can in
20 this case use dedicated and shared channels DPC, SPC at the same time, or else only one type of channel DPC, SPC (see also Figure 7).

If a subscriber station, for example MS2 or MS3, is
25 located in the boundary area of an area RNS of a base station controller RNC, then the soft handover process can be used to produce a smooth handover by ensuring a simultaneous supply from different base stations BS. In this case, the subscriber station MS2, MS3 is supplied
30 from base stations BS of different RNSs. The previous reservation of some of the channels for adjacent RNCs helps to ensure this double supply with little signaling complexity.

35 The nature of the channels for W-CDMA and TD-CDMA radio interfaces, respectively, will be explained with reference to Figures 5 and 6. Both cases are based on a broadband frequency band in which other multiplexing methods can be used for subscriber separation.

As shown in Figure 5, codes with different spread factors SF can be derived from a code tree, which is formed in accordance with DE 198 35 643. These codes can be shared between dedicated, shared and common channels DPC, SPC, CPC. The lower the spread factor SF, the higher is the data rate on that channel. The common channels CPC contain monitoring information (corresponding to BCCH, FACH, PCH) which is aimed at a number of subscriber stations MS, in the sense of a point-to-multipoint link.

As shown in Figure 6, the channel breakdown for TD-CDMA is as follows: one frame is, for example, subdivided into eight timeslots TS, in which case 16 channels in each timeslot TS1 to TS8 can be separated on the basis of their code 1 to 16. In TD-CDMA as well, channels can be subdivided into dedicated, shared and common channels DPC, SPC and CPC, with the channels being grouped, for example, on the basis of the timeslots. Further particular timeslots remain unused, since they have been assigned exclusively for allocation by an adjacent base station controller RNC. A subdivision into channels for unrestricted use and channels for restricted use can also be made both within the DPC and the SPC. The distinction is that channels are not allocated for restricted use until that channel has been checked. The process of measuring that channel, as has already been described, is carried out for this purpose. If the interference situation allows, the channel can then be assigned by the RNC for that radio cell.

Figure 7 shows a base station controller RNC via which the connections to subscriber stations MS1, MS2 to MS_m have been set up. This base station controller SRNC is referred to as the serving RNC or else the anchor RNC, since it remains responsible to the other network devices (MSC etc.) for these connections for the duration of such a connection. If a subscriber station MS1 or MS_m moves, during the connection, into the

monitored area of another RNC in which channels are reserved for it, which is referred to as a drift RNC (DRNC), then the SNRC can allocate channels from the reserved area by using the MAC-d entity which is responsible for the subscriber station MS to check with the SCT which is responsible for the new cell.

In the TDD transmission method, as an example for non-orthogonal resources in adjacent cells, matching complexity is also involved between the channel allocations of the individual radio cells in that particular RNS area, when adjacent radio cells are operated on the basis of time grouping in the same frequency band.

An entity MAC-d, in the sense of a process in the SRNC, is set up for each subscriber station MS, and this requests the radio resources for this subscriber station MS for the duration of the connection. The table SCT (shared channel table) is used in order to allocate channels to the subscriber station MS and, for those channels which are available in a radio cell, indicates which subscriber station MS1 to MSm may use which channel SPC1 to SPCmax, and with what priority (Prio). Furthermore, the table SCT indicates which subscriber station MS is using the channel at that time (used). If there is no entry in a field, then this means that this channel is not available for that subscriber station MS, for example SPC2 for MS1.

The tabular form is in this case used only to illustrate a clear form of resource management, in which case a pointer can be used to access the individual entries quickly. Other forms of representation are also possible.

The priorities for the access rights to the channels are defined in accordance with the requirements of RT or NRT services and the quality of service. This is an unchanging priority, which need not be varied

continuously. The unchanging prioritization of the subscriber stations MS and services in the table SCT can be adapted if the service combination or the services of a subscriber station MS change. The
 5 prioritization is carried out within the responsible RNC.

In the case of packet services for example, a dynamic priority, which is used within a group of subscriber
 10 stations MS having the same unchanging priority, can also be influenced by the following variables:

- subscriber station with a large number of temporarily stored data packet have high priority,
- data packets with a short maximum permissible
 15 delay time have a high priority, with the delay at that time also being taken into account if appropriate,
- subscriber stations with data packets which need to be transmitted repeatedly have a high priority.

20 The dynamic priority can be used to decide the channel allocation from frame to frame.

If one channel is allocated to a number of subscriber stations MS, then the subsequent allocation of the
 25 channel is governed by the highest unchanging priority. If the unchanging priority is the same for a number of subscriber stations, then the priority is governed by the higher dynamic priority. If even this does not result in any difference, then the previous allocation
 30 remains unchanged. This decision on the specific channel allocation is made from frame to frame, that is to say within 10 ms.

The prioritization process, in particular the
 35 unchanging priorities, allows the network operators to distinguish between services in order to offer services matched to specific market segments at appropriate prices.

In contrast to subscriber-related allocation of channels in adjacent RNSs, which would necessitate communication between the RNCs, the signaling complexity can be kept low if, according to the invention, channels of the adjacent RNS are always reserved for the RNC, and these channels can be made available without any checks.

Figure 7 shows the management process, just for the shared channels SPC. However, DPCs and SPCs do not require different treatment. Standard tables SCT can be set up for all types of channel DPC, SPC. Simply the joint management of all the resources in a radio cell overcomes a number of the disadvantages of using DPCs and SPCs that occur in the prior art. Synchronization of transmission for mixed use of DPCs and SPCs can be found in DE 198 57 041.

A subscriber station MS in Figure 8 is located in the boundary area of two radio cells (cell 1 and cell 2). However, these two radio cells are monitored by two different RNCs. The connection was originally set up in the SRNC, but the subscriber station MS is moving into the area RNS of the DRNC. The RNCs are connected to one another via an interface Iur. The two radio cells are formed by the base stations BS (often also referred to as NodeB) which are connected to the respective RNC via an interface Iub. The RNCs communicate via radio resource managers RRC (radio resource control), which handle the reservation of channels for adjacent RNCs.

Figure 9 shows, in simplified form, a method sequence for a soft handover corresponding to the illustration in Figure 8. Based on the situation in which the subscriber station MS has a connection to the cell 1, but requires that the active set of base stations BS involved in the connection be enlarged to include the cell 2, the method steps carried out are as follows.

In a first step (1), the device for radio resource management RRC in the SRNC reserves transmission capacity in cell 2 for the new subscriber station MS. If the channels available in cell 2 are not sufficient for the SRNC, a request is made to the RRC for the DRNS for the range of reserved channels to be enlarged.

In a second step (2), the RRC chooses from the SRNC the appropriate channels SPC or DPC in cell 2, and transmits the correspondingly calculated TFCS to both layer-1 entities and to the MAC-d entity for the base station BS supplying the subscriber station MS (the two TFCSs in the two cells may be different).

In a third step, the MAC-d entity receives available channels SPC and DPC in both cells during each frame interval by checking with the respective SCTs, and transmits the TFCI to both cells (the two TFCI parameters may be different). The nature of the signaling with TFCI can be found in DE 198 56 834.

After the handover to the cell 2 - the cell 1 no longer provides any channel for the subscriber station MS - the resource management responsible for the subscriber station MS at that time can also be handed over to the second RNC. The DRNC then becomes the SRNC. A handover becomes urgent when the previous DRNC cannot allocate channels in radio cells in which the subscriber station MS must be supplied.

Patent Claims

1. A method for resource allocation in a radio communications system, in which the resources are formed by channels in the radio interface between base stations (BS) and subscriber stations (MS), with regard to resource allocation, a number of base stations (BS) which are controlled by a first and a second base station controller (RNC), which belong to the same radio network, the base stations (BS) each provide a limited number of channels which can be allocated to connections from or to different subscriber stations (BS), characterized in that some of the channels which can be provided by one of the base stations (BS) are used for monitoring the first base station controller (RNC) associated with them, and are reserved for channel allocation to subscriber stations by the second base station controller, so that the second base station controller can provide these particular channels without communication with the first base station controller.
2. The method as claimed in claim 1, characterized in that the number of channels which are assigned to the second base station controller (RNC) is matched cyclically to the traffic volume.
3. The method as claimed in one of the preceding claims, characterized in that the radio interface uses TDMA-based transmission, and further particular channels are reserved for limited use by the first base station controller (RNC), which can be used only after prior channel measurements.

4. The method as claimed in claim 3, characterized in that resources which are as orthogonal as possible are allocated to the various base stations (BS) within the supply area of a base station controller (RNC).

5. The method as claimed in one of claims 1 or 2, characterized in that the radio interface is based on FDD transmission, and the channels which are assigned to the second base station controller (RNC) are used for carrying out a soft handover.

6. The method as claimed in one of the preceding claims, characterized in that the allocation of the channels is adapted dynamically from timeslot to timeslot.

7. The method as claimed in one of the preceding claims, characterized in that only one entity for resource monitoring (MAC-d) is set up in the base station controller (RNC) for each subscriber station (MS).

8. The method as claimed in claim 7, characterized in that the subscriber-related entities (MAC-d) of the individual subscriber stations (MS) interact in the base station controller (RNC).

9. The method as claimed in one of claims 7 or 8, characterized in that the subscriber stations (MS) are allocated priorities, and for a channel which is allocated to a number of subscriber stations (MS), the priority governs the use of the channel.

10. The method as claimed in claim 9, characterized in that, when priorities are equal, dynamic prioritization or a time sequence of a resource request governs the use of the channel.

11. The method as claimed in one of the preceding claims, characterized in that a resource table (SCT) is set up, which indicates for the channels which priority is allocated to which subscriber stations (MS) for that channel, and which subscriber station (MS) is currently using that channel.

12. The method as claimed in claims 7 and 11, characterized in that the resource table (SCT) is radio-cell-specific, and an entity requests channels from the resource tables (SCT) for the radio cells which are involved in the connection.

13. The method as claimed in one of the preceding claims, characterized in that a process of handing over control of a connection to a subscriber station (MS) to a further base station controller (RNC) is initiated only when the previously responsible base station controller (RNC) cannot allocate any channels in the necessary radio cell.

14. A radio communications system,
having base stations (BS) and subscriber stations (MS)
which are connected to one another via a radio
interface,

- in which case resources for the radio interface are formed by channels,
- in which case the base stations (BS) can each provide a limited number of channels, which can be allocated to connections from or to different subscriber stations (BS),

having a first and a second base station controller (RNC) which each control the resource allocation for a number of base stations (BS), and belong to the same radio network,

characterized by

control devices (RRC) which are allocated to the base station controllers (RNC) and reserve some of the channels of a base station (BS), which is allocated to the first base station controller, for channel

allocation to subscriber stations by the second base station controller (RNC), which can decide on the allocation of the channels to subscriber stations (MS) without any communication with the first base station controller.

2000-03-14

Figure captions:

- 1 Prior art
- 2 Channels
- 3 Radio cell monitored by RNC1
- 4 Radio cell monitored by RNC2
- 5 Radio cell monitored by RNC3
- 6 Legend:
 - DPC: dedicated channels
 - SPC: shared channels
- 7 SPC for RNC1
- 8 SPC for RNC2
- 9 SPC for RNC3
- 10 To MS1 (only DPC)
- 11 CPC: common channels
- 12 DPC and SPC for own MS
- 13 DPC and SPC for MS for other RNCs
- 14 DPC for unrestricted use of the RNC of the radio cell
- 15 DPC for restricted use of the RNC of the radio cell
- 16a not used
- 16b for non-orthogonal resources
- 17 MAC-d for MS1
- 18 MAC-d for MS2
- 19 MAC-d for MS_m
- 20 SCT for cell 1 (SRNC)
- 21 SCT for cell 2 (SRNC)
- 22 SCT for cell n (DRNC)
- 23 used
- 24 SCT for cell 1
- 25 SCT for cell 2
- 26 Reserve SPCs
- 27 L1 of cell 1
- 28 L1 of cell 2

FIG 1
Stand der Technik

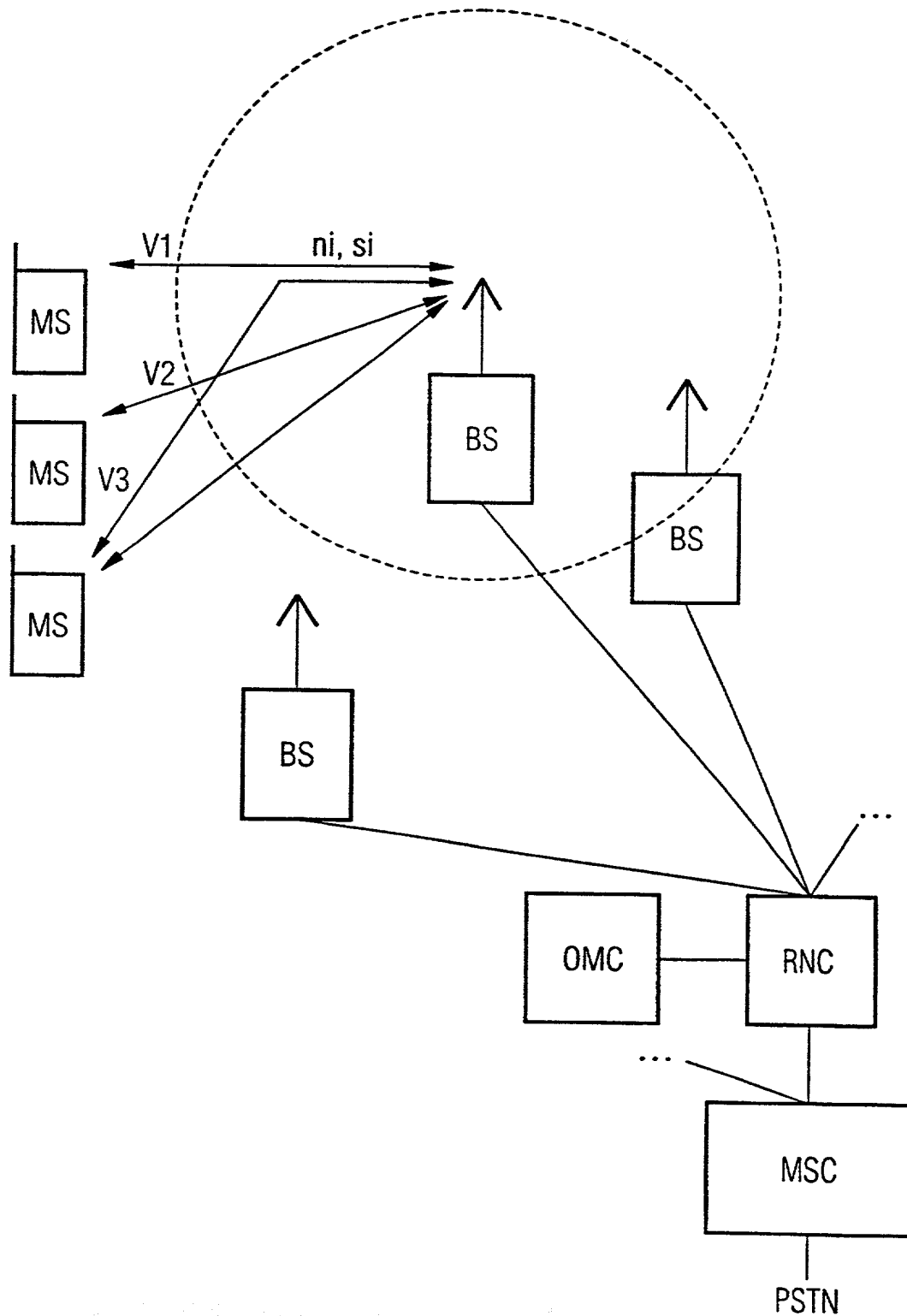


FIG 2

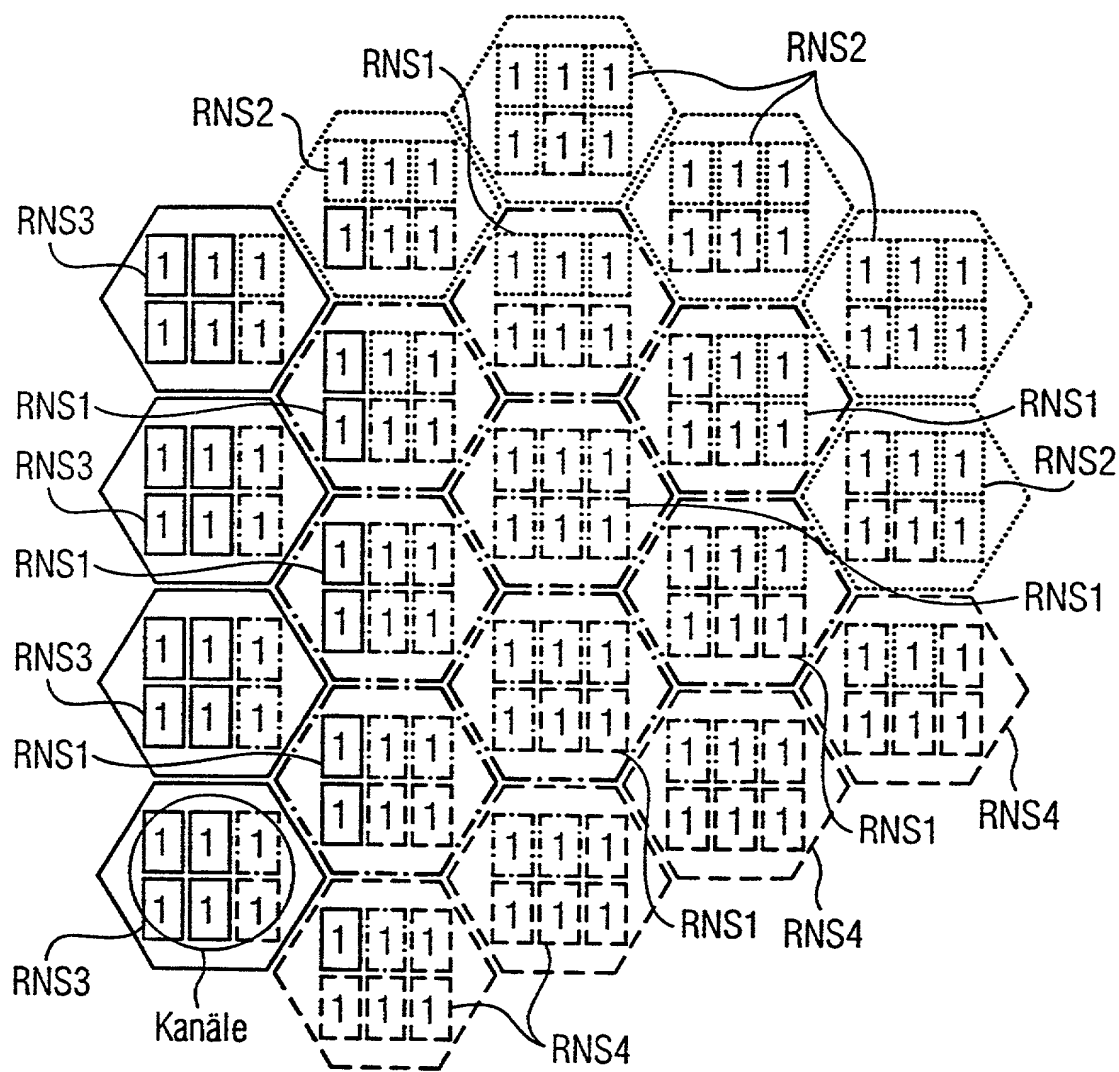


FIG 3

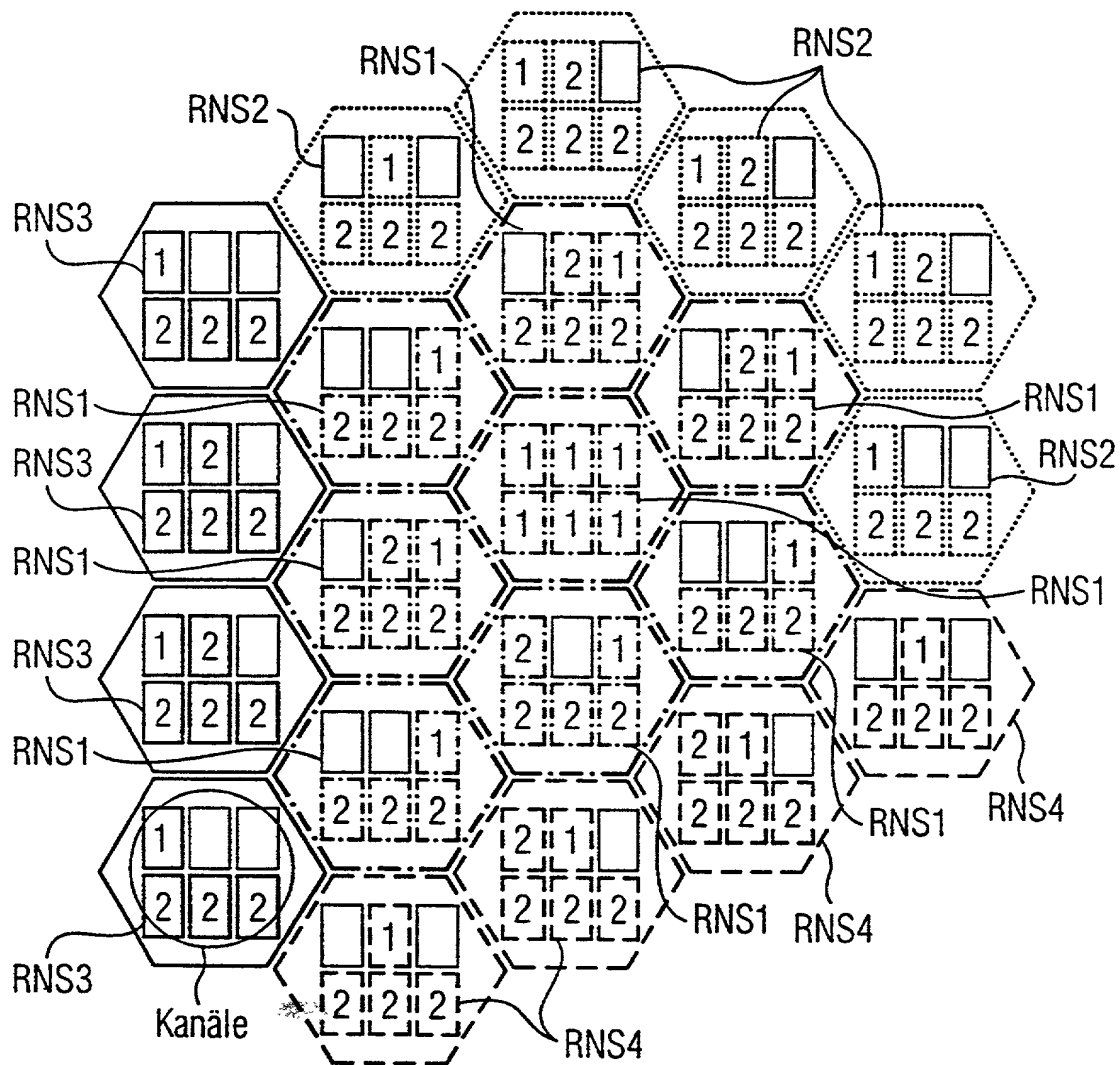
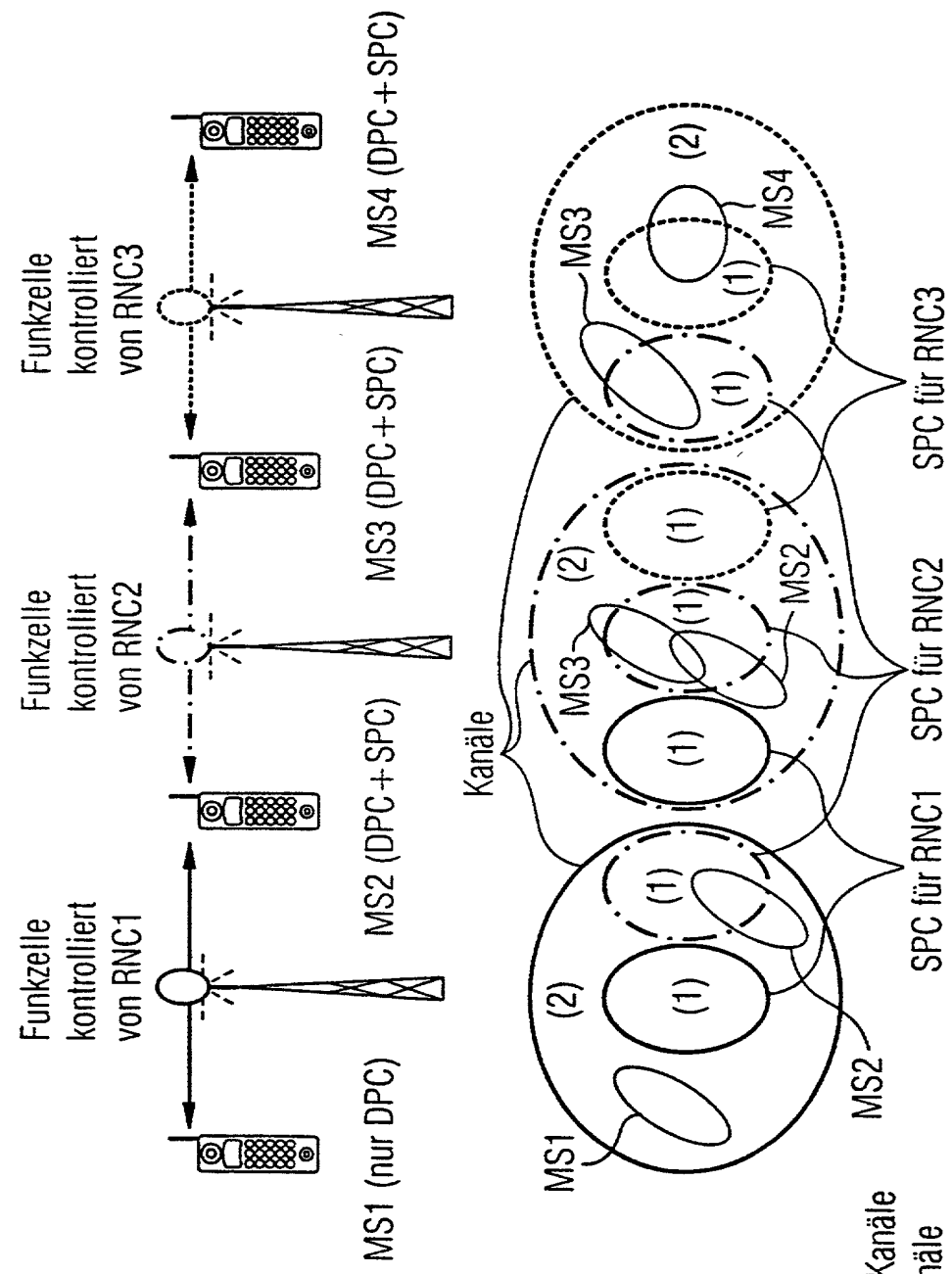


FIG 4



Legende:
 DPC: dedizierte Kanäle
 SPC: geteilte Kanäle

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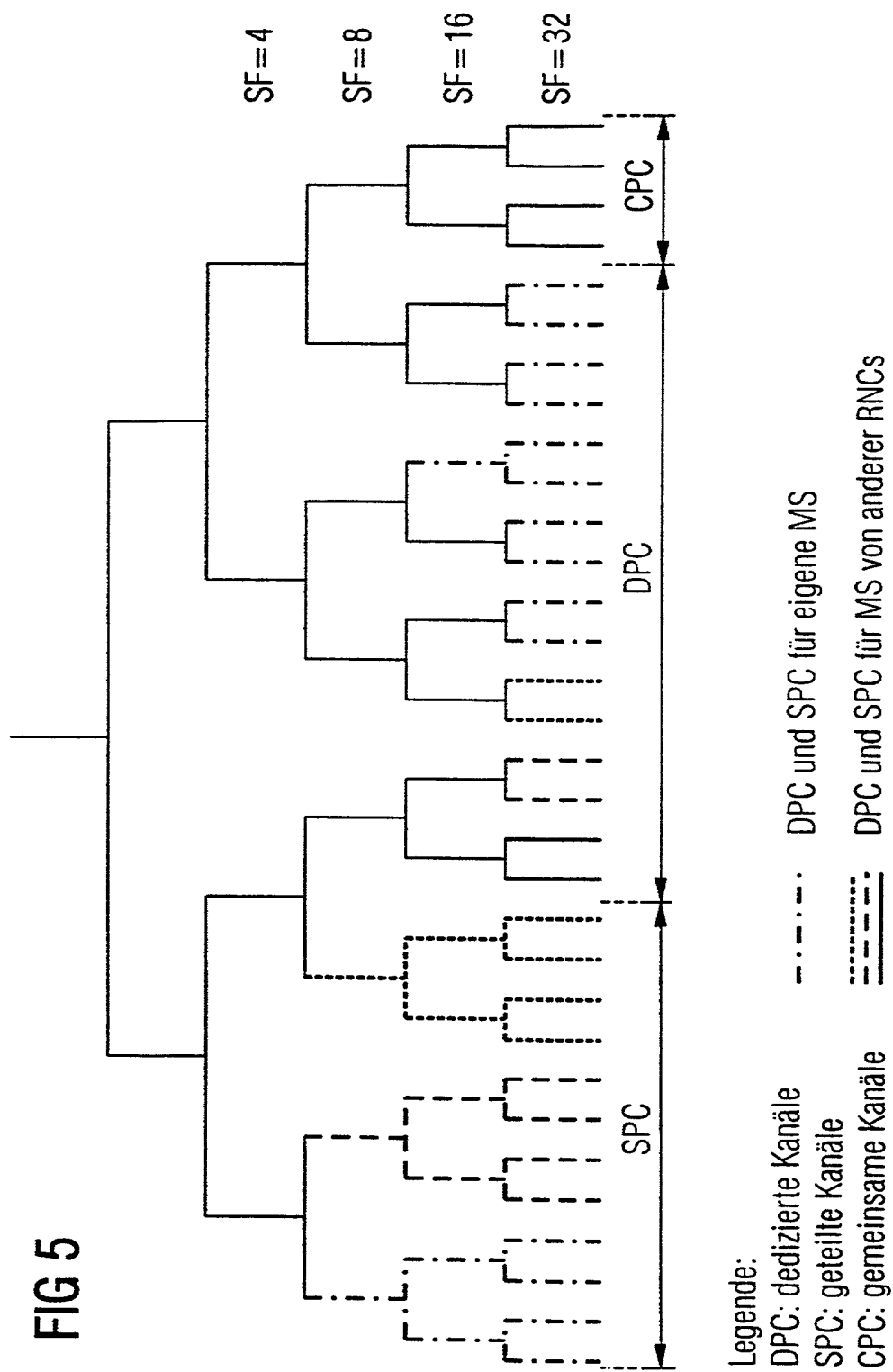


FIG 6

	TS1	TS2	TS3	TS4	TS5	TS6	TS7	TS8
Code 15	2	2	2	2	1			
	2	2	2	2	1			
	2	2	2	2	1			
Code 13	2	2	2	2	1			
	2	2	2	2	1			
Code 11	2	2	2	2	1			
	2	2	2	2	1			
Code 9	2	2	2	2	1			
	2	2	2	2	1			
Code 7	2	2	2	2	1			
	2	2	2	2	1			
Code 5	2	2	2	2	1			
	2	2	2	2	1			
Code 3	2	2	2	2	1			
	2	2	2	2	1			
Code 1	2	2	2	2	1			
	TS1	TS2	TS3	TS4	TS5	TS6	TS7	TS8
	SPC				DPC	unbenutzt		CPC

Legende:

DPC: dedizierte Kanäle

SPC: geteilte Kanäle

CPC: gemeinsame Kanäle

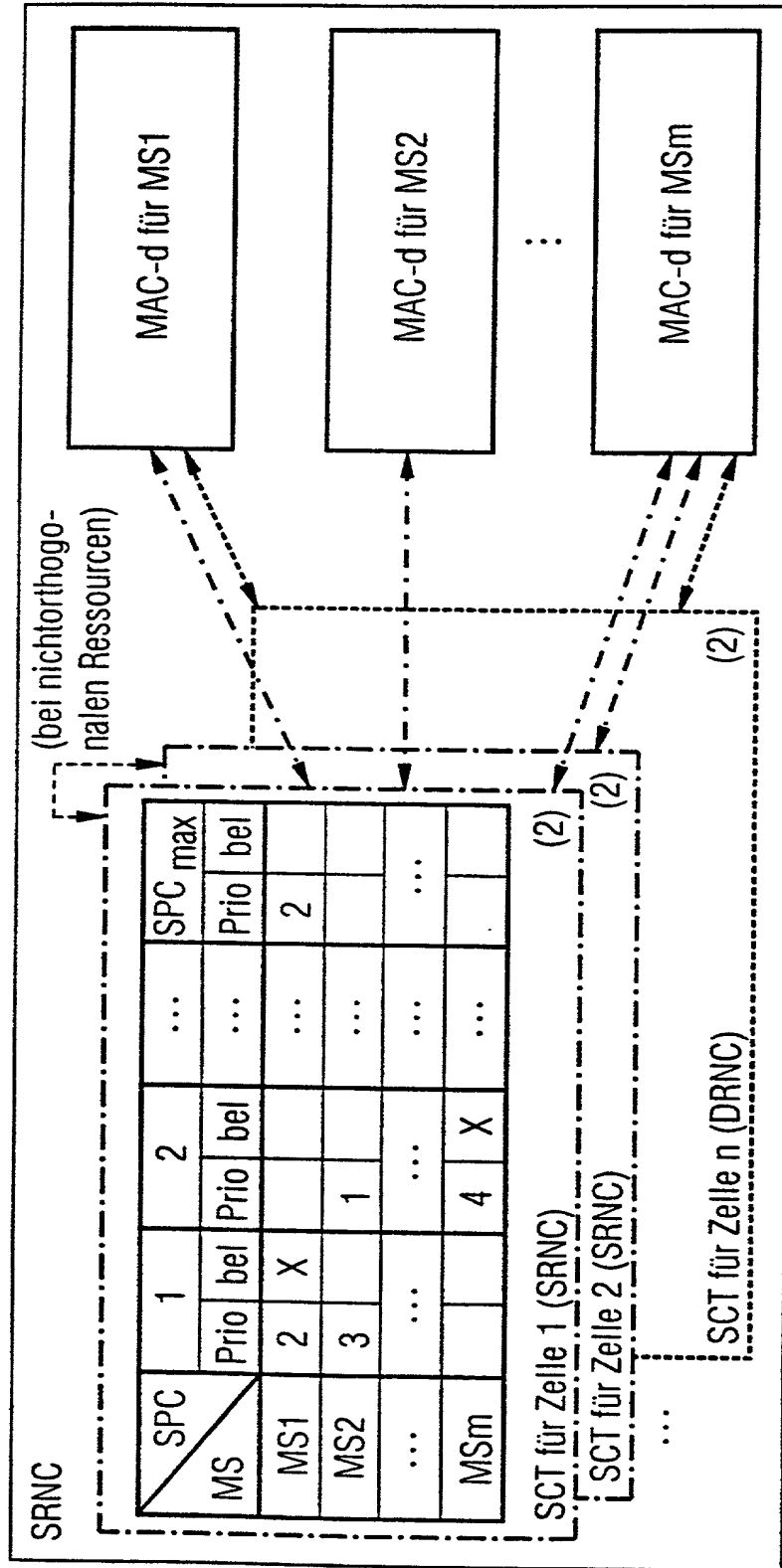
□

DPC zur unbeschränkten Nutzung des RNC der Funkzelle

[2]

SPC zur beschränkten Nutzung des RNC der Funkzelle

FIG 7



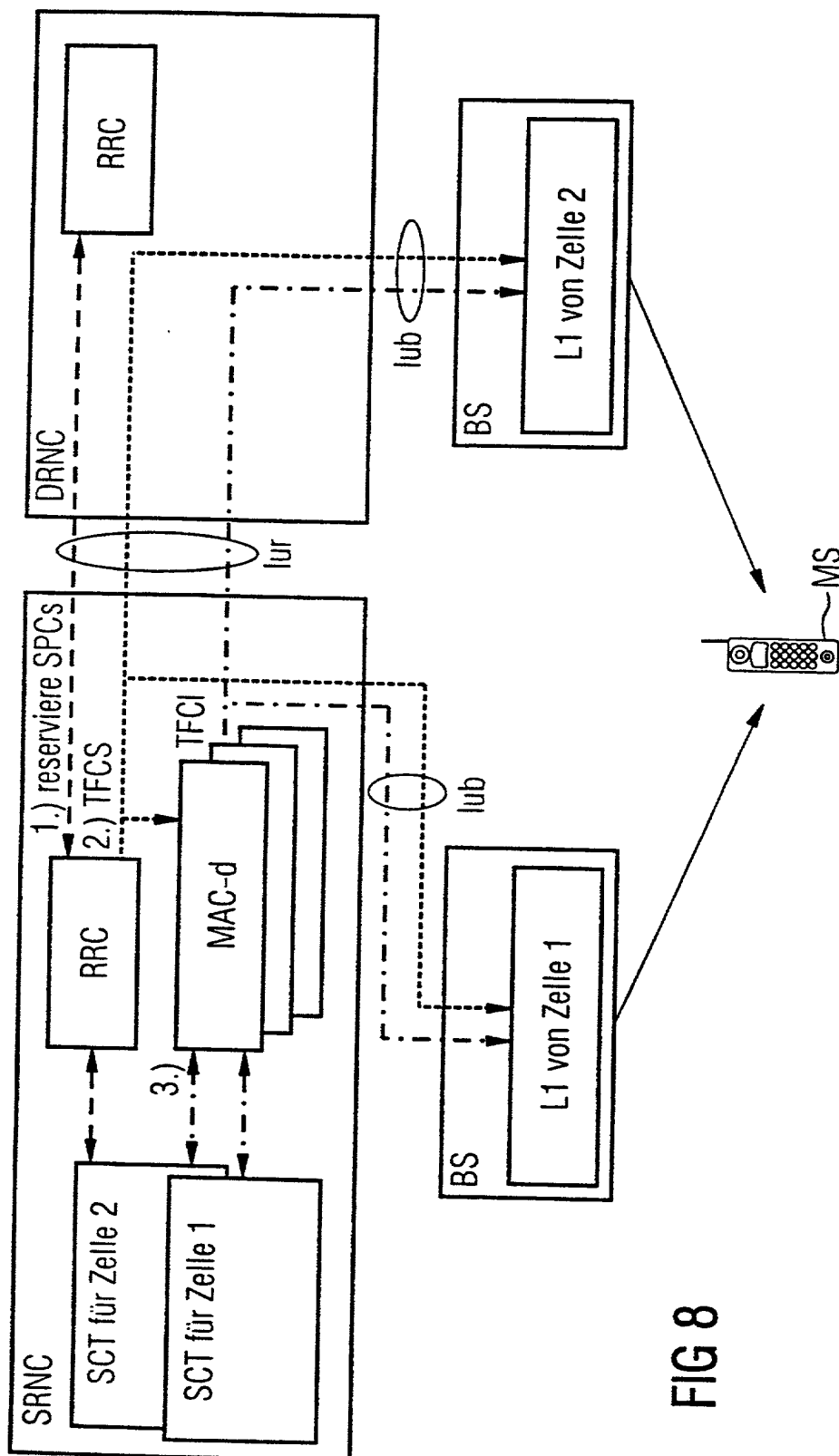
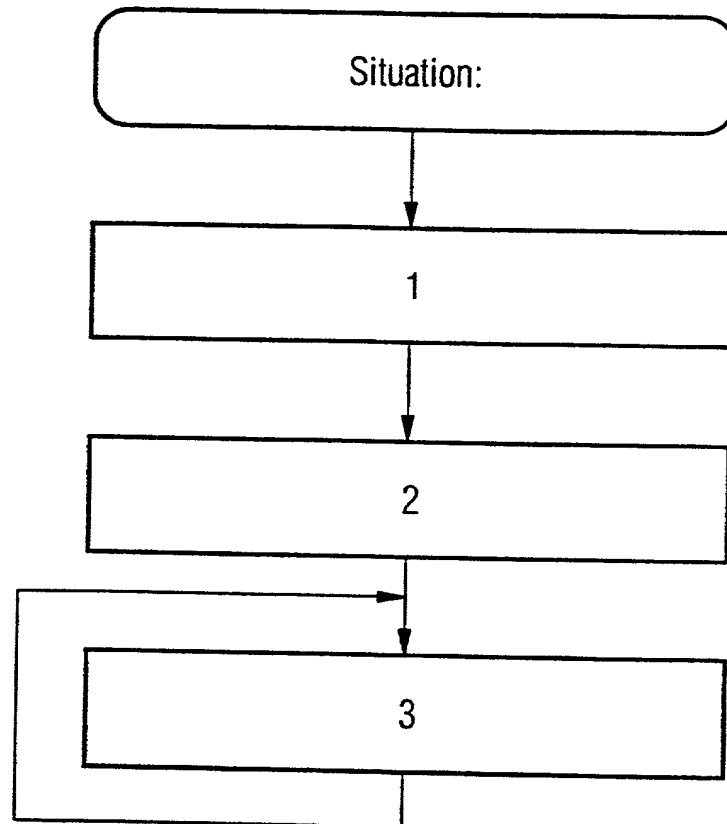


FIG 8

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FIG 9



Declaration and Power of Attorney For Patent Application

Erklärung Für Patentanmeldungen Mit Vollmacht

German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

As a below named inventor, I hereby declare that:

dass mein Wohnsitz, meine Postanschrift, und meine Staatsangehörigkeit den im Nachstehenden nach meinem Namen aufgeführten Angaben entsprechen,

My residence, post office address and citizenship are as stated below next to my name,

dass ich, nach bestem Wissen der ursprüngliche, erste und alleinige Erfinder (falls nachstehend nur ein Name angegeben ist) oder ein ursprünglicher, erster und Miterfinder (falls nachstehend mehrere Namen aufgeführt sind) des Gegenstandes bin, für den dieser Antrag gestellt wird und für den ein Patent beantragt wird für die Erfindung mit dem Titel:

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Verfahren zur Ressourcenzuteilung in einem Funk-Kommunikationssystem

Method for allocating resources in a radio communications system

deren Beschreibung

the specification of which

(zutreffendes ankreuzen)

(check one)

☐ hier beigefügt ist.

☐ is attached hereto.

☒ am 06.03.2000 als

☒ was filed on 06.03.2000 as

PCT internationale Anmeldung

PCT international application

PCT Anmeldungsnummer PCT/DE00/00694

PCT Application No. PCT/DE00/00694

eingereicht wurde und am

and was amended on

abgeändert wurde (falls tatsächlich abgeändert).

(if applicable)

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

German Language Declaration

Prior foreign applications
Priorität beansprucht

Priority Claimed

19909779.8

DE

05.03.1999

☒

☐

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

Yes
Ja

No
Nein

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐
Yes
Ja

☐
No
Nein

(Number)
(Nummer)

(Country)
(Land)

(Day Month Year Filed)
(Tag Monat Jahr eingereicht)

☐
Yes
Ja

☐
No
Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/00694

(Application Serial No.)
(Anmeldeseriennummer)

06.03.2000

(Filing Date D, M, Y)
(Anmeldedatum T, M, J)

anhängig

(Status)
(patentiert, anhängig,
aufgegeben)

pending

(Status)
(patented, pending,
abandoned)

(Application Serial No.)
(Anmeldeseriennummer)

(Filing Date D,M,Y)
(Anmeldedatum T, M; J)

(Status)
(patentiert, anhängig,
aufgeben)

(Status)
(patented, pending,
abandoned)

Ich erkläre hiermit, dass alle von mir in der vorliegenden Erklärung gemachten Angaben nach meinem besten Wissen und Gewissen der vollen Wahrheit entsprechen, und dass ich diese eidesstattliche Erklärung in Kenntnis dessen abgebe, dass wissentlich und vorsätzlich falsche Angaben gemäss Paragraph 1001, Absatz 18 der Zivilprozessordnung der Vereinigten Staaten von Amerika mit Geldstrafe belegt und/oder Gefängnis bestraft werden können, und dass derartig wissentlich und vorsätzlich falsche Angaben die Gültigkeit der vorliegenden Patentanmeldung oder eines darauf erteilten Patentes gefährden können.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

German Language Declaration

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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

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And I hereby appoint

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Ext. _____

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Unterschrift des Erfinders <i>Volker Sommer</i>	Datum <i>13.8.01</i>	Second Inventor's signature	Date
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Postanschrift SCHWABSTEDTER WEG 6		Post Office Address SCHWABSTEDTER WEG 6	
13503 BERLIN		13503 BERLIN	

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).